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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/726,705

12/04/2003

Masato Koyama

246155US2SRD

7037

22850

7590

03/08/2006

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EXAMINER

HU, SHOUXIANG

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 03/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/726,705

Applicant(s)

KOYAMA ET AL.

Examiner

Shouxiang Hu

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 December 2005.  
2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.  
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 18-28 is/are pending in the application.  
4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
6) ☒ Claim(s) 18-28 is/are rejected.  
7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☒ All b) ☐ Some \* c) ☐ None of:  
1. ☒ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 12/20/05, 12/04/03.

- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.  
5) ☐ Notice of Informal Patent Application (PTO-152)  
6) ☐ Other: \_\_\_\_\_.

## EXAMINER'S AMENDMENT

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 18-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeshi (Takeshi et al., JP 2002-299607; 10-11-2002; of record) in view of Hamanaka (Hamanaka et al., US 6,548,421) and/or Tanaka (JP 1-102966; 4-22-1989).

Takeshi discloses method of manufacturing a semiconductor device (Figs. 1-6; also see the machine translation for rough references in English); comprising: forming an insulating layer (113; HfSiO) containing metal, silicon and oxygen on a substrate (101), such an insulating layer is naturally amorphous as it is formed with a material set and a method both substantially the same as that of the instant invention, wherein the amorphous insulating layer further containing nitrogen in its surface region (116 or 113); and forming a polysilicon gate electrode (104) thereon; and, wherein the nitrogen concentration in the surface region of the amorphous insulating layer in Takeshi can be more than 10% (see Paragraph 0013 and claim 4), which naturally covers a concentration of 15 atom% or more, for obtaining the desirable diffusion barrier effect of the insulating layer (Paragraphs 0008).

Although Takeshi does not expressly disclose that the method further comprises a heat treatment step for dopant activation in at a temperature of between about 950 and about 1000 C-degrees in an non-oxidizing atmosphere, one of ordinary skill readily recognized that such activation heat treatment step is commonly included in such a method for activating the dopants and/or for improving the crystal structure of the semiconductor materials therein, as readily evidenced in the prior art such as: Hamanaka (see col. 7, lines 1-10), and/or Tanaka (see its English abstract).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the art-known activation heat treatment step of Hamanaka and/or Tanaka into the method of Takeshi with the nitrogen concentration in the surface region of the amorphous insulating layer being more than 15%, per the further teaching of Takeshi, so that a method for forming a device with activated dopants and/or with improved crystal structures in the semiconductor materials and/or with improved diffusion barrier effect in the insulating layer would be obtained. And, such heat treatment step would inherently permit a solid-phase growth to take place in a region containing no nitrogen or low nitrogen in the amorphous insulating layer while remaining the nitrogen-containing surface region as an amorphous insulating layer, thereby forming an epitaxial crystalline insulating layer containing the metal, silicon and oxygen on and in contact with the substrate (such inherency is readily evidenced in the instant specification, such as page 16 therein).

Regarding claims 22, 24 and 26, the total thickness of layer 113 in Takeshi is about 5 nm (see [0025]), which makes the thickness of the layer 116 appear to be about

2.5 nm as shown in Fig. 6C. In addition, it is noted that the thicknesses of such layers are art-recognized parameters of importance subject to routine experimentation and optimization.

Regarding claims 23 and 25, the recited steps in the method are also disclosed in Takeshi (see [0060] and [0061]).

Regarding claims 25 and 26, it is noted that it is art known that a nitridated metal compound layer can also be commonly formed with a direct deposition of the compound in a nitrogen atmosphere for simplifying the process steps.

### ***Response to Arguments***

Applicant's arguments and declaration both filed on December 20, 2005, have been fully considered but they are not persuasive.

Applicant's main arguments includes: (A) Takeshi requires the nitrogen concentration near the interface with silicon substrate to be higher than in other parts; (B) Takeshi would not lead to the claimed in invention since that would not produce the required 0.1 atom% nitrogen concentration near the interface with silicon substrate.

In response to Argument A above, it is noted that the nitrogen concentration near the interface with silicon substrate in Takeshi is inherently lower than in other parts (see paragraphs 0060), since the nitrogen atoms therein are introduced from the top surface in a manner substantially same as the one in the instant invention. What is said in the abstract may contains an obvious typo about it, given that the crux of the invention of Takeshi is to form an nitrogen-rich barrier layer (116 or 111) near the gate electrode,

while still maintaining low nitrogen concentration near the interface with the silicon substrate (see especially paragraphs 0058 through 0061).

With respect to Argument B, first, it is noted that the features regarding the nitrogen concentration near the interface with the silicon substrate is not recited in the rejected claim(s). Furthermore, the comparison between the nitrogen concentration profiles of Sekine et al. and that of Takeshi does not appear to be valid one, since the method and/or process conditions of the two are not necessarily the same; and the nitrogen profile is a function of various process conditions, including peak nitrogen concentration, the initial thickness of the originally introduced nitrogen-rich layer, the post annealing temperature and atmosphere, among others. For example, Sekine requires a post-nitridation annealing in oxygen at a temperature up to 1000 C-degrees and/or the thickness of the nitrogen-rich top layer to be 3 nm or more (see Fig. 10); and, none of these is readable on the method of Takeshi. Moreover, the nitridation method of Takeshi can also be implemented through excited nitrogen, in a manner substantially same as the one of the instant invention. Accordingly, applicant's arguments appear to directly contradict to applicant's own invention, which already proves that the nitrogen concentration at a region near the interface with the substrate can even be maintained to be zero, even though it may reach as high as 15 atom% or more at the top surface region (see the originally presented claims 7 and 8).

***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

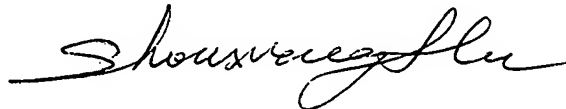
A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is 571-272-1654. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SH  
February 23, 2006

A handwritten signature in black ink, appearing to read 'Shouxiang Hu', written in a cursive style.

**SHOUXIANG HU**  
**PRIMARY EXAMINER**